SOUTH DAKOTA STATEWIDE FISHERIES SURVEY

2102-F21-R-40

Name: Lake Carthage **County**: Miner
Legal Description: T108R- R57W- Sec. 4-5, 8
Location from nearest town: ½ mile east of Carthage, SD

Dates of present survey: July 31-August 1, 2007 (netting), June 8, 2007 (electrofishing)
Dates of last survey: August 3-4, 2005 (netting), June 5, 2005 (electrofishing)

Primary Game Species	Other Species
Largemouth Bass	Northern Pike
Bluegill	Black Bullhead
Black Crappie	Yellow Perch
Channel Catfish	Carp
	White Sucker
	Walleye

PHYSICAL DATA

Surface area when full: 203 acres **Watershed area:** 94,574 acres
Maximum depth: 24 feet **Mean depth:** 8 feet
Volume: 1,550 acre-feet **Shoreline length:** 4 miles
Contour map available: Yes **Date prepared:** 1970
Lake elevation observed during the survey: 3 feet low
Beneficial use classification: (4) warmwater permanent fish propagation, (7) immersion recreation, (8) limited-contact recreation, (9) fish and wildlife propagation and stock watering.

Introduction

Lake Carthage was originally a 38-acre impoundment built on Redstone Creek by the Works Progress Administration (WPA) in 1936. It was named for the nearby town of Carthage. By the early 1960s, erosion from the watershed had silted in the lake, ruining the fishery and the dam and spillway needed repairs. In 1964, a new dam was built downstream that increased the size of the lake to 203 acres.

Ownership of Lake and Adjacent Lakeshore Properties

Lake Carthage is owned and managed by the South Dakota Department of Game, Fish and Parks (GFP). The majority of the lakeshore and surrounding land (430 acres) is owned by GFP. The remainder is privately owned.

Fishing Access

The Lake Carthage Recreation Area, located on the east side of the lake, contains a boat ramp with a dock, public toilet, swimming beach, picnic tables, and areas for primitive camping. There are many areas accessible to shore fishermen.

Field Observations of Water Quality and Aquatic Vegetation

The water in Lake Carthage was turbid and green with algae with a Secchi depth of 38 cm (15 inches). Common cattail (*Typha spp.)* was plentiful in shallow areas and some sago pondweed (*Potamogeton pectinatus)* was also observed.

BIOLOGICAL DATA

Methods:

Lake Carthage was sampled on July 31-August 1, 2007 with ten overnight trap-net sets. The trap nets are constructed with 19-mm-bar-mesh (¾ in) netting, 0.9 m high x 1.5 m wide (3 ft high x 5 ft wide) frames and 18.3 m (60 ft) long leads. Two hours of nighttime electrofishing were done on June 8, 2007 to assess the largemouth bass population. Sampling locations are displayed in Figure 5.

Results and Discussion:

Trap Net Catch

Black bullheads (79.1%) were the most common species sampled in the trap nets followed by channel catfish (6.4%) and common carp (4.8%). Black crappie, white sucker, bluegill, hybrid sunfish, northern pike, yellow perch, and walleye were also sampled.

Table 1. Total catch from ten overnight trap net sets at Lake Carthage, Miner County, July 31-August 1, 2007.

Species	Number	Percent	CPUE	80% C.I.	Mean CPUE*	PSD	RSP-P	Mean Wr
Black Bullhead	3,665	79.1	366.5	±185.5	578.1	0	0	87
Channel Catfish	297	6.4	29.7	±15.4	6.5	80	0	93
Common Carp	224	4.8	22.4	±5.6	5.1	3	0	80
Black Crappie	185	4.0	18.5	±14.3	41.9	13	4	128
White Sucker	146	3.2	14.6	±6.9	7.9	100	100	84
Bluegill	90	1.9	9.0	±3.1	19.5	22	1	104
Hybrid Sunfish	10	0.2	1.0	±0.3	0.0	--	--	--
Northern Pike	8	0.2	0.8	±0.5	1.1	--	--	--
Yellow Perch	7	0.2	0.7	±0.5	1.0	--	--	--
Walleye	1	0.0	0.1	±0.1	0.3	--	--	--

* 7 years (1993, 1995, 1997, 1999, 2001, 2003, 2005)

Largemouth Bass

Management objective: Maintain a largemouth bass fishery with an electrofishing CPH of at least 20 for stock length (≥20 cm, 8 in) and longer fish and a RSD-P of 20-40.

In 2007, largemouth bass CPUE increased slightly (Table 2) but it is still below average and our management objective. Most sampled bass were three years old and were likely from the 2006 stocking (Table 3), since no age-1 bass were sampled in the 2005 survey. These fish grew from an average of 228 g (0.5 lbs.) when stocked to 366 g (0.81 lbs.) when sampled in the survey a year later. Pit tags were placed on all stock length bass sampled by electrofishing to allow future evaluation. Mean growth for all age classes exceeds regional, statewide and small lakes and impoundments means and the fish were in excellent condition.

Table 2. Largemouth bass electrofishing CPUE, PSD, and mean Wr for Lake Carthage, Miner County, 1999-2007.

	1999	2000	2001	2002	2003	2004	2005	2006	2007	Mean*
CPUE	21.0		9.0		12.5		8.5		9.0	10.0
PSD	45		100		8		100		53	79
RSD-P	36		56		8		18		29	36
Mean Wr	104		104		120		111		109	107

*7 years (1995-1997, 1999, 2001, 2003, 2005)

Table 3. Average back-calculated lengths (mm) for each age class of largemouth bass in Lake Carthage, Miner County, 2007.

			Back-calculation Age							
Year Class	Age	N	1	2	3	4	5	6	7	8
2006	1	1	81							
2004	3	11	127	216	276					
2003	4	1	104	232	285	336				
2002	5	1	167	300	354	384	410			
2001	6	2	101	233	305	359	396	414		
2000	7	2	106	230	269	320	369	416	432	
All Classes		**18**	**114**	**242**	**298**	**350**	**392**	**415**	**432**	
Statewide Mean			96	182	250	305	342			
Region III Mean			111	212	287	347	383			
SLI* Mean			99	183	246	299	332			

*Small Lakes and Impoundments

Black Crappie

Management objective: Maintain a crappie fishery with a trap-net CPUE of at least 20 and PSD of at least 40.

Black crappie CPUE increased to the highest level seen since 1997 (Table 4). However, the percentage of fish longer than 25 cm (10 inches) decreased this year due to an abundance of smaller fish in the sample (Table 4 and Figure 2). Black crappie condition is excellent and growth was similar to statewide and small lakes and Regional means, but faster than the small lakes and impoundments means (Table 5). Recruitment of young crappies to the population is consistent but low.

Table 4. Black crappie trap-net CPUE, PSD, and mean Wr for Lake Carthage, Miner County, 1999-2007.

	1999	2000	2001	2002	2003	2004	2005	2006	2007	Mean*
CPUE	9.5		7.4		16.1		7.4		18.5	51.6
PSD	71		80		35		66		13	63
RSD-P	1		18		7		34		4	20
Mean Wr	111		113		110		118		128	116

*6 years (1995, 1997, 1999, 2001, 2003, 2005)

Table 5. Average back-calculated lengths (mm) for each age class of black crappie in Lake Carthage, Miner County, 2007.

			Back-calculation Age							
Year Class	Age	N	1	2	3	4	5	6	7	8
2006	1	86	80							
2005	2	83	86	149						
2004	3	12	83	152	185					
2002	5	4	95	187	225	247	282			
All Classes		**185**	**86**	**162**	**205**	**247**	**282**			
Statewide Mean			83	147	195	229	249			
Region III Mean			95	167	219	253	274			
SLI* Mean			78	134	180	209	226			

*Small Lakes and Impoundments

Bluegill

Management objective: Maintain a bluegill fishery with a trap-net CPUE of at least 20 and RSD-18 of at least 20.

A large bluegill year class was produced in 2004 after several years of poor reproduction (Tables 6 and 7) but CPUE remains well below our management objective. Bluegill condition is good (Table 6) and although growth was slower than statewide and regional means, it is similar to small lakes and impoundments means (Table 7).

Table 6. Bluegill trap-net CPUE, PSD, RSD-18, RSD- P, and mean Wr for Lake Carthage, Miner County, 1999-2007.

	1999	2000	2001	2002	2003	2004	2005	2006	2007	Mean*
CPUE	6.8		5.5		4.2		65.1		9.0	19.9
PSD	91		95		98		32		22	81
RSD-18	47		78		78		10		2	52
RSD-P	7		18		62		8		1	21
Mean Wr	99		109		109		122		104	109

*6 years (1995, 1997, 1999, 2001, 2003, 2005)

Table 7. Average back-calculated lengths (mm) for each age class of bluegill in Lake Carthage, Miner County, 2007.

			Back-calculation Age							
Year Class	Age	N	1	2	3	4	5	6	7	8
2006	1	8	60							
2005	2	10	38	95						
2004	3	53	49	110	133					
2003	4	8	32	87	144	154				
2002	5	9	34	92	121	144	152			
2001	6	1	50	139	163	198	207	214		
All Classes		**89**	**44**	**104**	**140**	**165**	**180**	**214**		
Statewide Mean			55	103	141	166	180			
Region III Mean			60	116	157	180	190			
SLI* Mean			53	101	138	163	180			

*Small Lakes and Impoundments

Channel Catfish

Management objective: Maintain a channel catfish fishery with a trap-net CPUE of at least 5.

Channel catfish CPUE increased significantly since 2003 and is well above our management objective (Table 8). Figure 5 suggests two large year classes were naturally produced, probably in 2005 and 2006 (Figure 5).

Table 8. Channel catfish trap-net CPUE, PSD, RSD-P and mean Wr for Lake Carthage, Miner County, 1999-2007.

	1999	2000	2001	2002	2003	2004	2005	2006	2007	Mean*
CPUE	0.2		0.9		6.6		32.3		29.7	7.6
PSD	--		--		6		34		80	35
RSD-P	--		--		0		0		0	0
Mean Wr	--		--		92		91		93	92

*6 years (1995, 1997, 1999, 2001, 2003, 2005)

Black Bullhead

Management objective: Maintain a bullhead fishery with a trap-net CPUE of no more than 100.

Black bullhead CPUE increased dramatically in 2007 and once again exceeds the management objective (Table 9). The bullheads sampled ranged in length from 12-21 cm (4.7-8.3 in) with a mean length of only 156 mm (6.1 in).

Table 9. Black bullhead trap-net CPUE, PSD, RSD-P and mean Wr for Lake Carthage, Miner County, 1999-2007.

	1999	2000	2001	2002	2003	2004	2005	2006	2007	Mean*
CPUE	1959.4		761.0		847		34.1		366.5	672.6
PSD	1		5		52		23		0	16
RSD-P	0		0		1		1		0	1
Mean Wr	--		80		95		92		87	89

*6 years (1995, 1997, 1999, 2001, 2003, 2005)

All Species

Black crappie, black bullhead, common carp, and white sucker populations have increased while most of the other fish populations have remained fairly stable (Table 10).

Table 10. Gill-net (GN) and trap-net (TN) CPUE for all fish species sampled in Lake Carthage, Miner County, 1999-2007.

Species	1999	2000	2001	2002	2003	2004	2005	2006	2007
COC (TN)	7.6		0.1		1.7		17.3		22.4
WHS (TN)	10.9		1.5		9.2		10.4		14.6
BLB (TN)	1,959		761.0		847.0		34.1		366.5
CCF (TN)	0.2		0.9		6.6		32.3		29.7
NOP (TN)	1.9		0.7		0.9		0.1		0.8
HYB (TN)	--		--		--		0.3		1.0
BLG (TN)	6.8		5.5		4.5		65.1		9.0
LMB (TN)	--		0.1		0.2		0.1		--
BLC (TN)	9.5		7.4		16.1		7.4		18.5
YEP (TN)	0.2		--		0.1		4.0		0.7
WAE (TN)	0.3		--		1.7		--		0.1

NOP (Northern Pike), COC (Common Carp), WHS (White Sucker), BLB (Black Bullhead), CCF (Channel Catfish), HYB (Hybrid Sunfish), BLG (Bluegill), LMB (Largemouth Bass), BLC (Black Crappie), YEP (Yellow Perch), WAE (Walleye)

MANAGEMENT RECOMMENDATIONS

1. Control the black bullhead population by a combination of predator management, commercial fishing and Department removals.

2. Stock advanced-size largemouth bass as needed to supplement limited natural reproduction. Evaluate stocking efforts through marking and periodic electrofishing.

3. Enhance shoreline cover by placing and anchoring trees to the banks of the lake. Observe and document fish usage during electrofishing surveys.

4. Consider periodic drawdowns to improve water quality and habitat.

Table 11. Stocking record for Lake Carthage, Miner County, 1991-2007.

Year	Number	Species	Size
1991	3,465	Walleye	Lrg. Fingerling
1992	39,000	Largemouth Bass	Med. Fingerling
1993	4,757	Walleye	Lrg. Fingerling
	108	Walleye	Juvenile
1995	10,150	Walleye	Sml. Fingerling
1996	5,000	Walleye	Sml. Fingerling
2002	25,300	Largemouth Bass	Fingerling
2004	225	Channel Catfish	Adult
2005	230	Channel Catfish	Adult
2006	115	Largemouth Bass	Adult
2007	692	Walleye	Adult

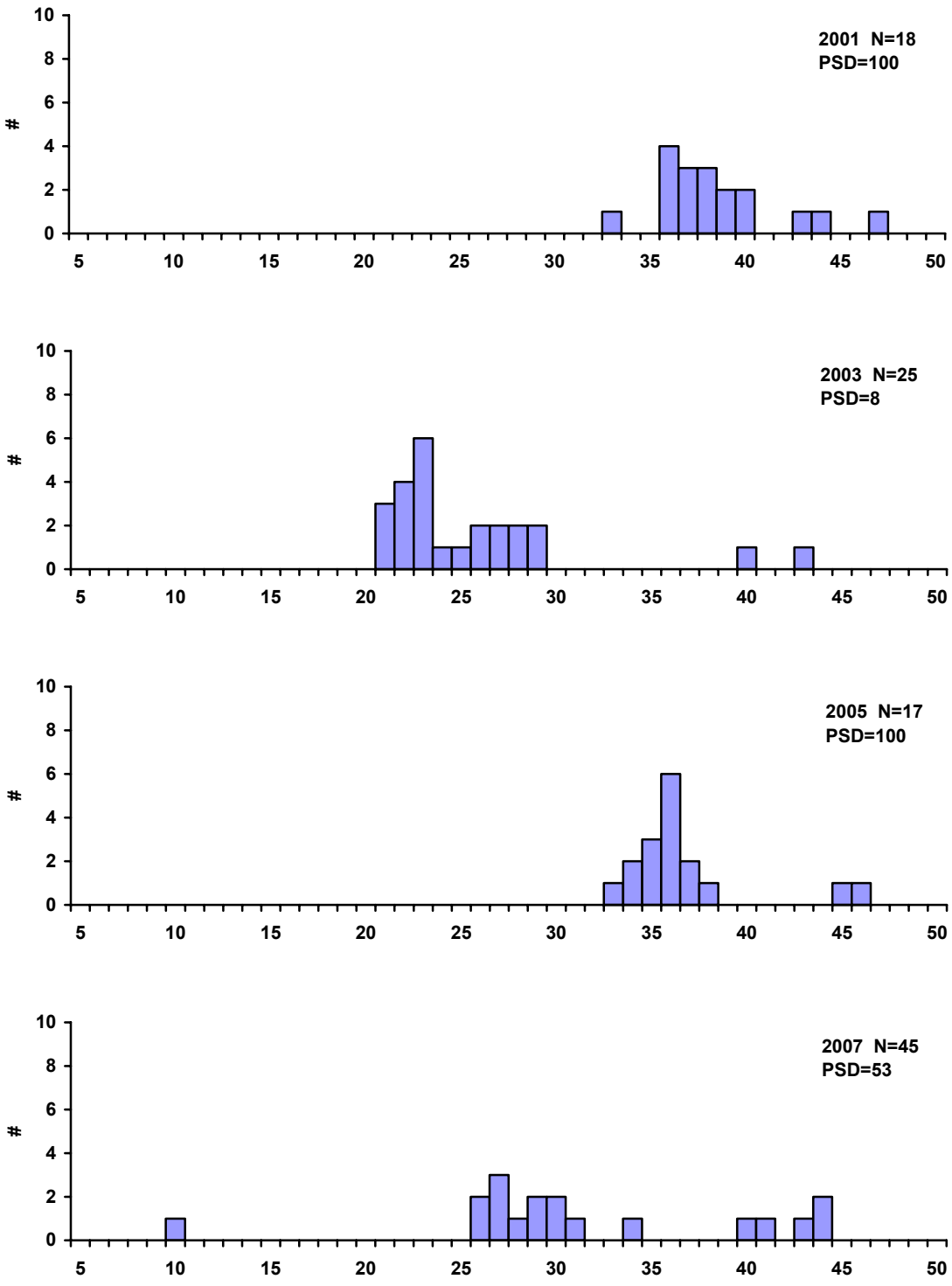

Figure 1. Length frequency histograms for largemouth bass sampled by electrofishing in Lake Carthage, Miner County, 2001, 2003, 2005, and 2007.

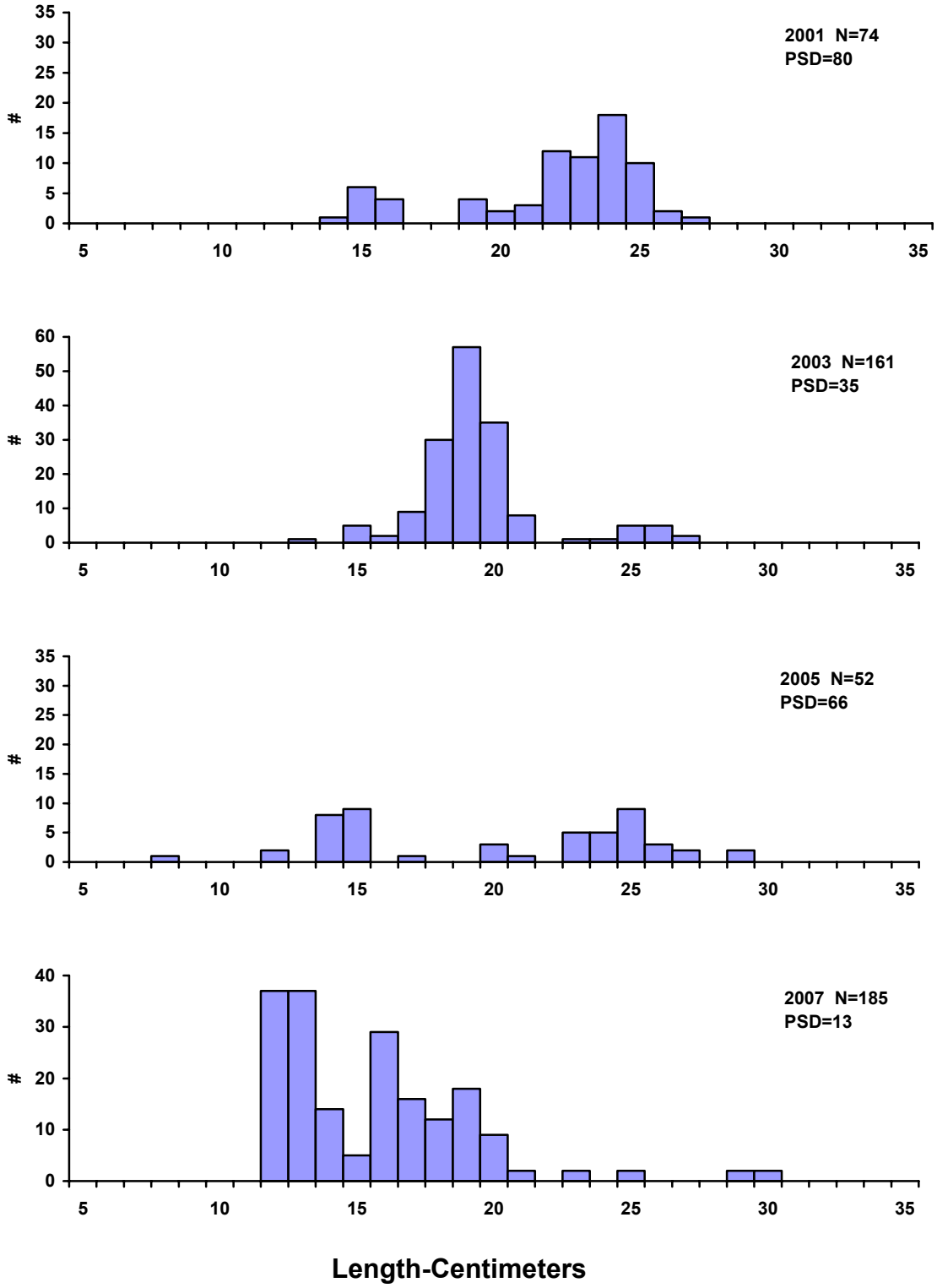

Figure 2. Length frequency histograms for black crappies sampled with trap nets in Lake Carthage, Miner County, 2001, 2003, 2005, and 2007.

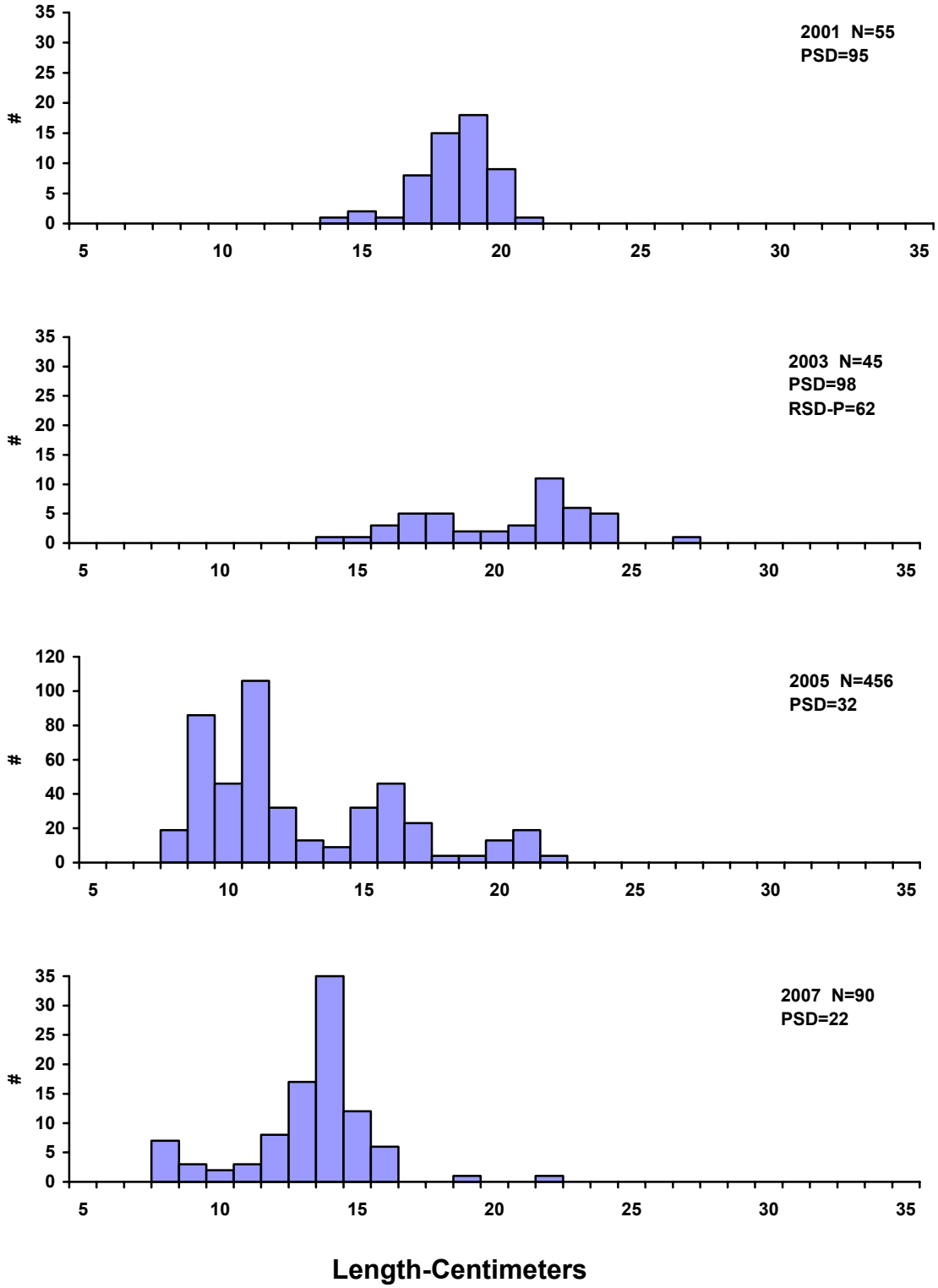

Figure 3. Length frequency histograms for bluegill sampled with trap nets in Lake Carthage, Miner County, 2001, 2003, 2005, and 2007.

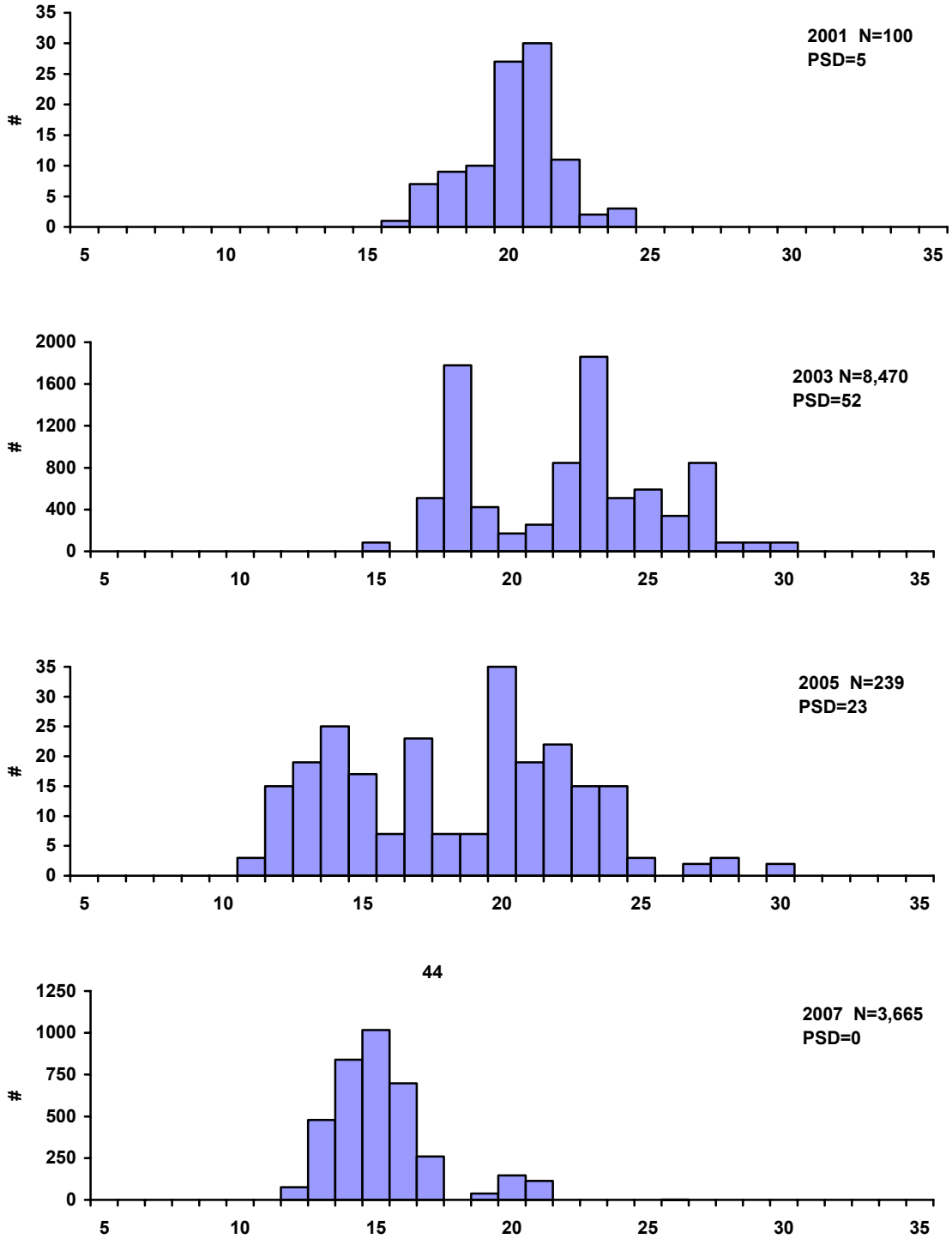

Figure 4. Length frequency histograms for black bullheads sampled with trap nets in Lake Carthage, Miner County, 2001, 2003, 2005, and 2007.

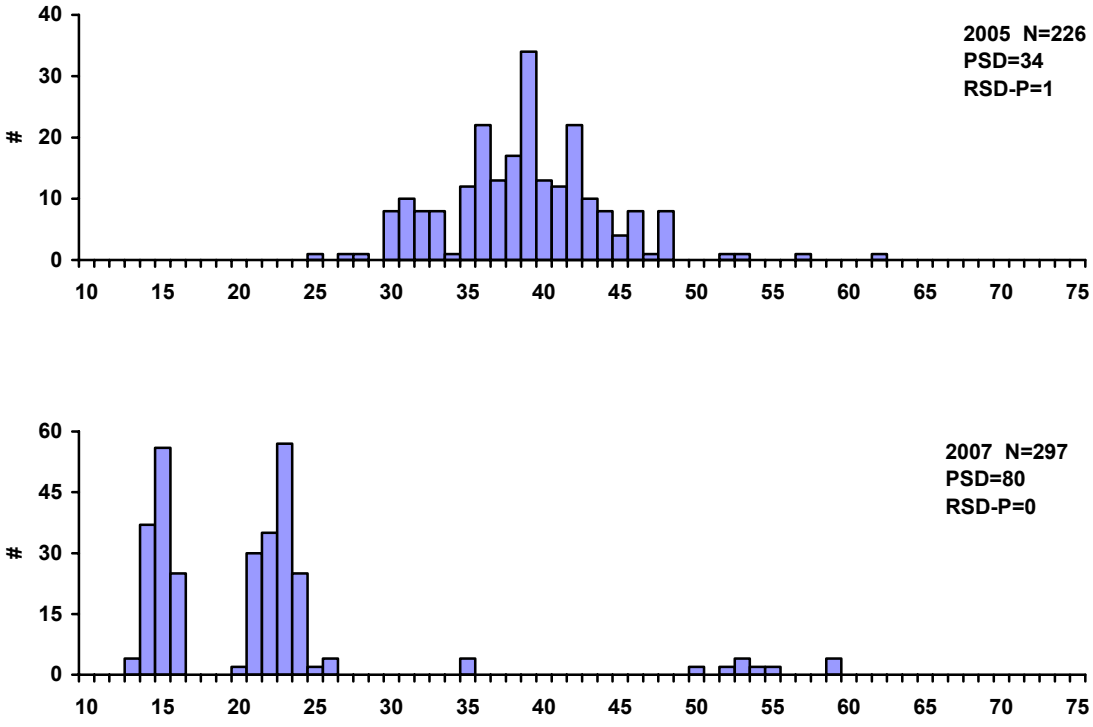

Figure 5. Length frequency histograms for channel catfish sampled with trap nets in Lake Carthage, Miner County, 2005, and 2007.

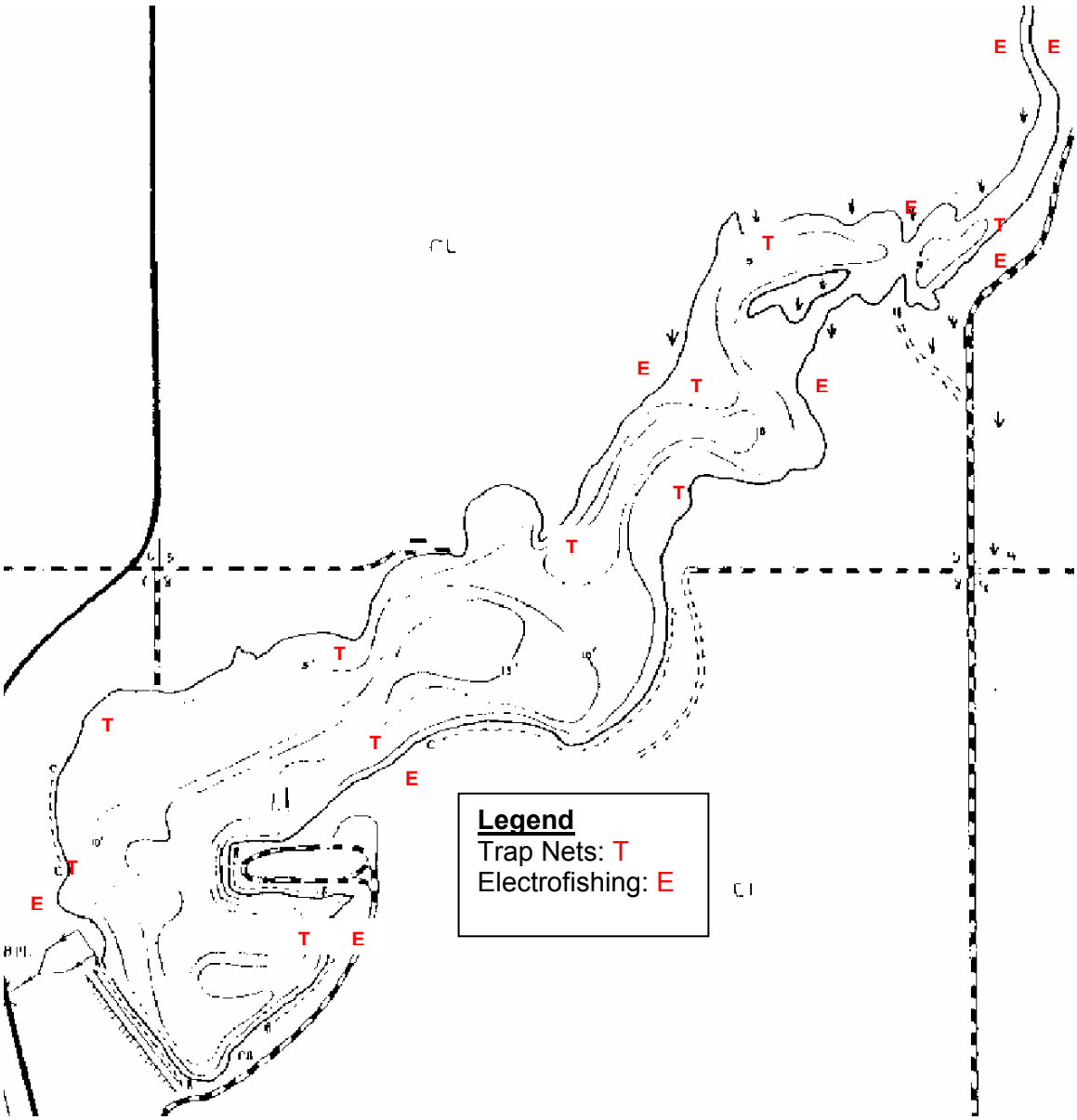

Figure 5. Sampling locations on Lake Carthage, Miner County, 2007.

Appendix A. A brief explanation of catch per unit effort (CPUE), proportional stock density (PSD), relative stock density (RSD) and relative weight (Wr).

Catch Per Unit Effort (CPUE) is the catch of animals in numbers or in weight taken by a defined period of effort. Can refer to trap-net nights of effort, gill-net nights of effort, catch per hour of electrofishing, etc.

Proportional Stock Density (PSD) is calculated by the following formula:

$$PSD = \frac{\text{Number of fish} > \text{quality length}}{\text{Number of fish} \geq \text{stock length}} \times 100$$

Relative Stock Density (RSD-P) is calculated by the following formula:

$$RSD\text{-}P = \frac{\text{Number of fish} > \text{preferred length}}{\text{Number of fish} \geq \text{stock length}} \times 100$$

PSD and RSD-P are unitless and usually calculated to the nearest whole digit.

Size categories for selected species found in Region 3 lake surveys, in centimeters.

Species	Stock	Quality	Preferred	Memorable	Trophy
Walleye	25	38	51	63	76
Sauger	20	30	38	51	63
Yellow perch	13	20	25	30	38
Black crappie	13	20	25	30	38
White crappie	13	20	25	30	38
Bluegill	8	15	20	25	30
Largemouth bass	20	30	38	51	63
Smallmouth bass	18	28	35	43	51
Northern pike	35	53	71	86	112
Channel catfish	28	41	61	71	91
Black bullhead	15	23	30	38	46
Common carp	28	41	53	66	84
Bigmouth buffalo	28	41	53	66	84
Smallmouth buffalo	28	41	53	66	84

For most fish, 30-60 or 40-70 are typical objective ranges for “balanced” populations. Values less than the objective range indicate a population dominated by small fish while values greater than the objective range indicate a population comprised mainly of large fish.

Relative weight (Wr) is a condition index that quantifies fish condition (i.e., how much does a fish weigh for its length). A Wr range of 90-100 is a typical objective for most fish species. When mean Wr values are well below 100 for a size group, problems may exist in food and feeding relationships. When mean Wr values are well above 100 for a size group, fish may not be making the best use of available prey.